

## PCT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

Commissioner  
US Department of Commerce  
United States Patent and Trademark  
Office, PCT  
2011 South Clark Place Room  
CP2 5C24  
Arlington, VA 22202  
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in its capacity as elected Office

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<b>Applicant</b> BRAUER, John, Lionel et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

22 December 2000 (22.12.00)

☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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CORRECTED VERSION

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
7 December 2000 (07.12.2000)

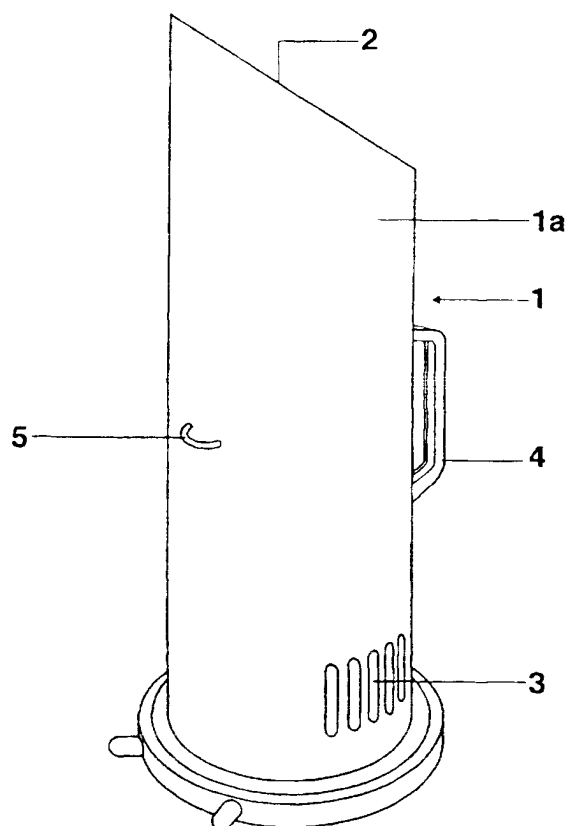
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(10) International Publication Number  
**WO 00/74187 A1**

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- (21) International Application Number: **PCT/AU00/00617**
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PQ 0638 31 May 1999 (31.05.1999) AU  
PQ 5864 25 February 2000 (25.02.2000) AU
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- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO,

[Continued on next page]

(54) Title: **OZONE GENERATING APPARATUS**



(57) Abstract: Corona discharge apparatus which is simply and robustly constructed from readily available materials can be used for producing ozone from air and in a body of water. All forms of apparatus are of a substantially elongate cylindrical configuration and in one form of the invention the apparatus can be readily adapted for ozone production in water to production from air.

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## OZONE GENERATING APPARATUS

### TECHNICAL FIELD

This invention relates to ozone generating apparatus and has particular relevance to apparatus which operates on corona discharge principles, utilises the phenomenon of air breakdown when electric stress on the surfaces of a conductor exceeds certain values.

### BACKGROUND ART

Ozone is used in a wide range of industrial applications such as in the bottling industry to disinfect bottles, in brewing, by the pharmaceutical industry as a disinfectant, in the manufacture of electric components to oxidise surface impurities to breakdown industrial waste like phenol and cyanide so that they become biodegradable, to oxidise mining waste, and for the treatment of harmful compounds such as heavy metals, ethanol and ascetics. It also oxidises phenolics, pesticides, detergents and aromatic (smelly) compounds.

It has also been long recognised that polluted indoor air is a health hazard that causes disease, lost work days and in general reduces quality of life.

Pollution indoors can often exceed outdoor levels and the transmission of respiratory infections in indoor environments continues to be a substantial health concern.

There are many contaminants which contribute to indoor air pollution and the controlled treatment of living environments with ozone will substantially improve conditions.

Excessive levels of ozone can result in the poisoning of humans or animals and it is therefore necessary to control ozone outputs in relation to an environment being treated.

There are numerous enterprises which specialise in the production of ozone generating apparatus and treatments but to date available apparatus has tended to be technically crude, expensive and inefficient.

It is an object of the present invention to provide an ozone

generating apparatus which is efficient compact and one which can be produced at relatively modest cost and be tailored for specific situations.

Ozone is also used for water treatment purposes using what are known as aeration or venturi methods.

5           A typical venturi installation as is known in the art involves the placement of a ozone generating apparatus adjacent to a waterline. Ozone produced by the apparatus is introduced into a waterline using a venturi device placed in a waterline bi-pass from the waterline.

It is a further object of the present invention to provide an ozone  
10 generating apparatus for general purposes and one which is readily adapted  
for the treatment of water, air and other bodies of fluid.

Further objects and advantages of the present invention will become apparent from the ensuing description which is given by way of example.

15 DISCLOSURE OF INVENTION

According to the present invention there is provided a corona discharge apparatus comprising an elongate positive electrode, an elongate dielectric sleeve mounted co-axially with the positive charge electrode and an elongate negative electrode mounted co-axially with the dielectric sleeve characterised in that the elongate positive electrode is an interference fit with the negative dielectric.

The positive electrode can be a metal rod provided with an external thread.

The negative electrode can be provided with an irregular surface providing venting spaces between the outermost portions of the electrode and the dielectric sleeve.

The negative electrode can be metal mesh in the form of a cylindrical sleeve or wrap.

The apparatus can include an elongate tubular outer housing  
30 and means for creating a forced draft in an axial direction throughout the  
housing.

According to another aspect of the present invention there is

provided a corona discharge apparatus comprising positive (outer) and negative (inner) electrodes separated by an air gap and a dielectric member characterised in that the positive and negative electrodes and the dielectric member are co-axial and the air gap between the negative electrode and the dielectric is created by spacers.

The spacers can be resilient o-rings.

The air gap can be defined by the tubular electrode and the spacers.

The air gap is communicable with the interior of the negative electrode.

The inner electrode can be provided with wall apertures which allow air to enter and exit the air gap and internal blocks adapted to divert airflow to and from the air gap.

The inner and outer electrodes can be metal tubes.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Aspects of the present invention will now be described with reference to the accompanying drawings in which;

Figures 1 to 1c are diagrammatic side perspective views of aspects of an ozone generating apparatus in accordance with one possible embodiment of the present invention, and

Figure 2, 3 and 4 are top, side and exploded views of a further form of corona discharge unit for the ozone generating apparatus of the present invention, and

Figure 5 to 5d are systematic drawings of possible outer electrode arrangements for a corona discharge apparatus of the present invention, and

Figures 6 is a side view and partial cross-section of an electrode according to the present invention, and

Figure 7 is a cross-sectional drawing of the electrode of figure 6 taken at vii:vii.

With respect to figures 1 to 1(d) of the drawings apparatus according to the present invention may comprise a body generally indicated

by arrow 1 which includes a generally tubular outer casing 1a (shown in figure 1 only).

The casing 1a may be provided with vents 2, 3 and may include a carrying handle 4 and attachment means 5.

5           The casing may be cylindrical (as illustrated) square or rectangular (not shown).

The outer surface of the casing 1a of the body 1 may mount an auxiliary and coaxial fan (not shown).

10           Figures 1(b), 1(c) and 1(d) of the drawings are side perspective views of the device of the present invention with the casing 1a removed.

The device is provided with a base generally indicated by arrow 7 an ozone producing region indicated by arrow 8.

The ozone producing region 8 and an internal fan 9 may be fixed to the base 7 by inverted U-shaped rails 10.

15           The base 7 which may be moulded or fabricated in metal or plastic secures free ends 10a of the rails 10 and receives an electrical power cord 11.

The base 7 can house programmable control means (not shown) within a sealed housing 12.

20           The free (upper ends) of the rails 10 can provide support for a corona discharge apparatus generally indicated by arrow 13.

In the example illustrated the frame or casing of the fan 9 is a push fit on the rails 10. In the alternative the frame or body of the fan 9 may fit between the rails 10 in such a manner that it can be repositioned without  
25           the need for dismantling.

With respect to figures 2 to 4 of the drawings in accordance with a further possible embodiment of the present invention corona discharge apparatus generally indicated by arrow 15 may be housed within a tube generally indicated by arrow 16.

30           The tube 16 may be made of an ozone resistant material and be in many forms and sizes.

The function of the tube is to isolate the immediate environment

of the corona discharge apparatus from turbulent air which is induced or blown into the generator casing by the main fan and to furthermore improve delivery of ozone from the corona discharge unit.

In other respects the construction of the ozone generator is  
5 similar to that previously described.

The discharge unit 15 has positive and negative chargeable electrodes 17, 18 interposed by a dielectric element 19.

Positive electrode 17 can be in the form of a stainless steel rod or bolt charged via electrical connection 20.

10 The negatively charged electrode 18 may be in the form of a tubular wound or wrapped stainless steel mesh charged via an independent electrical connection (now shown).

The dielectric element 19 can be in the form of a ceramic tube.

Where the positively charged electrode 17 is in the form of a  
15 bolt the elements of the discharge unit can be conveniently assembled using a nut 21 and washer 22.

A resilient ring 23 can be interposed between washer 22 and the element 19 to lessen the risk of damage to same when assembly nut 21 is tightened.

20 The corona discharge unit 15 can be centralised in tube 16 by a support 24.

The length of the mesh electrode 18 may be varied to suit.

As mentioned earlier the tube 16 can be of varying sizes and configurations.

25 In figure 3 the tube 16 is elongate and has inlet and outlet nozzles 25, and 26 of reduced size with a view to improving the delivery of ozone from the unit.

An auxiliary fan 27 may be positioned within the tube 16 to further enhance ozone delivery from the tube.

30 In some instances a glass tube corona discharge unit may be specified.

The corona discharge apparatus figures 5 to 5(d) illustrate other



aspects of the present invention.

In figure 5 the apparatus has two series wired negative electrodes 18.

In figure 5a the apparatus has four series connected negative  
5 electrodes 18 joined by a metal crimp bar 30.

Figure 5b is a sectional drawing taken at V(b):V(b) of figures 5 and 5a. The arrangement shows negative electrodes 18 in the form of a metal mesh wrap on the dielectric 19 where the free ends 32, of the mesh forming the electrode 18 are joined by a crimped bar 30, clamped and pulled  
10 taut by the crimp bar.

In figure 5c shows that a negative electrode 18 which is of an irregular surface shape can provide a corona discharge "skin" over the dielectric 19 through which air can pass. The depth of the corona discharge skin is approximately equivalent to the overall depth of the electrode 17.  
15 Various kinds of mesh, punched plates and the like can be provided to create this effect.

In figure 5d a positive electrode 18 is created by a material having lengthwise triangular fluting 33. Such an arrangement also provides a corona discharge skin through which air can freely pass.

20 With respect to figures 6 and 7 of the drawings the present invention also provides an corona discharge apparatus generally indicated by arrow 34 having positive (outer) and negative (inner) electrodes 35 and 36 respectively separated by an airgap 37 and a dielectric 38.

The electrodes 35, 36 and dielectric 38 are co-axial tubular  
25 members and the airgap 37 is created by spacers 39.

The spacers 39 can be o-ring seals made of a resilient ozone resistant material such a viton, and are set in grooves 40 in the face of the inner electrode 36.

The air gap 37 is an annular chamber defined by the inner walls  
30 of the dielectric 38, o-rings 39 and the outer walls of the inner electrode 36.

Access to the interiors of the air gap 37 is provided by apertures 41 and 41a in the walls of the inner electrode 36.

The inner electrode 35 and/or the dielectric can be connected to incoming and outgoing airlines 42, 43 respectively.

Single or dual plugs 44 prevent the passage of air into the interiors of the inner electrode 36.

5           When the electrodes 35, 36 are charged and a forced draft of air or oxygen is applied to airline 42 plugs 44 block the air and divert it into the interiors of the airgap 37 via the apertures 41, 41a.

The forced air draft now containing ozone is released to the airline 43 via apertures 41a.

10           The size and volume of the air gap can be adjusted by altering the spacings of the o-rings and/or their size.

The apparatus described is readily adapted for introducing ozone into fluid pipes or other bodies of water. The apparatus can also be used as a general purpose ozone generator for air treatment.

15           The apparatus of figures 6 and 7 can be readily adapted for ozone production from air. The inner tube electrode takes the place of the solid rod electrode of the previously described embodiment and the positive electrode is replaced by a negative mesh electrode.

20           The apparatus is constructed from readily available tubestocks and the robust construction ensures maximum operating efficiencies can be maintained.

Apparatus in accordance with the present invention has many advantages including:

- 25           (a)     the ability to increase commercial profits by extending shelf life of agricultural and horticultural commodities during storage and transit,
- (b)     improved quality of agricultural and horticultural commodities by inhibiting microbial growth on product surfaces,
- 30           (c)     lowering the risk of pathogenic agents and cross-contamination in food handling environments,
- (d)     the improved quality of indoor air by eliminating

- unpleasant and hazardous odours and reducing risk of respiratory infections and effects of chemical pollutants,
- (e) the enhancements of hygiene by accessing and sterilising difficult to clean places, all of which can be achieved with no chemical residue build-up.

5

Aspects of the present invention have been described by way of example only and it will be appreciated that modifications and additions thereto may be made without departing from the scope thereof, as defined in the appended claims.

## CLAIMS:

1. Corona discharge apparatus comprising an elongate positive electrode, an elongate dielectric sleeve mounted co-axially with the positive electrode and an elongate negative electrode mounted co-axially with the dielectric sleeve characterised in that the elongate positive electrode is an interference fit on the elongate negative electrode.  
5
2. Corona discharge means as claimed in claim 1 wherein the positive electrode is a metal rod provided with an external thread.
3. Corona discharge means as claimed in claim 1 wherein the negative electrode is provided with an irregular surface provide an air spaces between the outermost portions of the electrode and the dielectric sleeve.  
10
4. Corona discharge means as claimed in claim 1 wherein the negative electrode is a metal mesh in the form of a cylindrical sleeve or wrap.
5. Corona discharge means as claimed in claim 1 including an elongate tubular outer housing and means for creating a forced draft in an axial direction throughout the housing.  
15
6. Corona discharge apparatus comprising positive (outer) and negative (inner) electrodes separated by an air gap and a dielectric member characterised in that the positive and negative electrodes and the dielectric member are co-axial and the air gap between the negative electrode and the dielectric is created by spacers.  
20
7. Corona discharge apparatus as claimed in claim 6 wherein the spacers are resilient O-rings.
8. Corona discharge apparatus as claimed in claim 6 wherein the air gap is defined by the tubular electrode and the spacers.  
25
9. Corona discharge apparatus as claimed in claim 6 wherein the inner electrode is provided with wall apertures which allow air to enter and exit the air gap and internal blocks which divert airflow from the air gap.

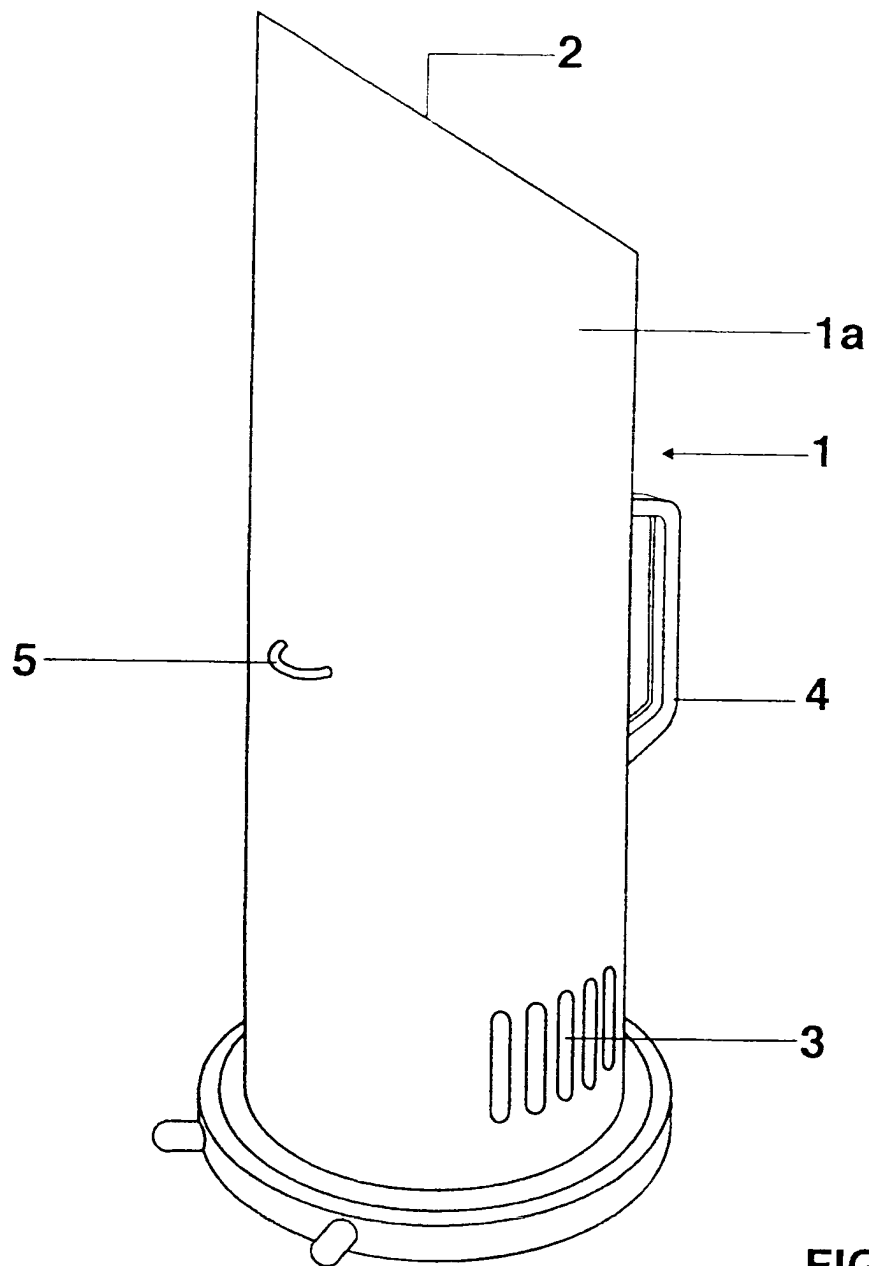


FIG 1.

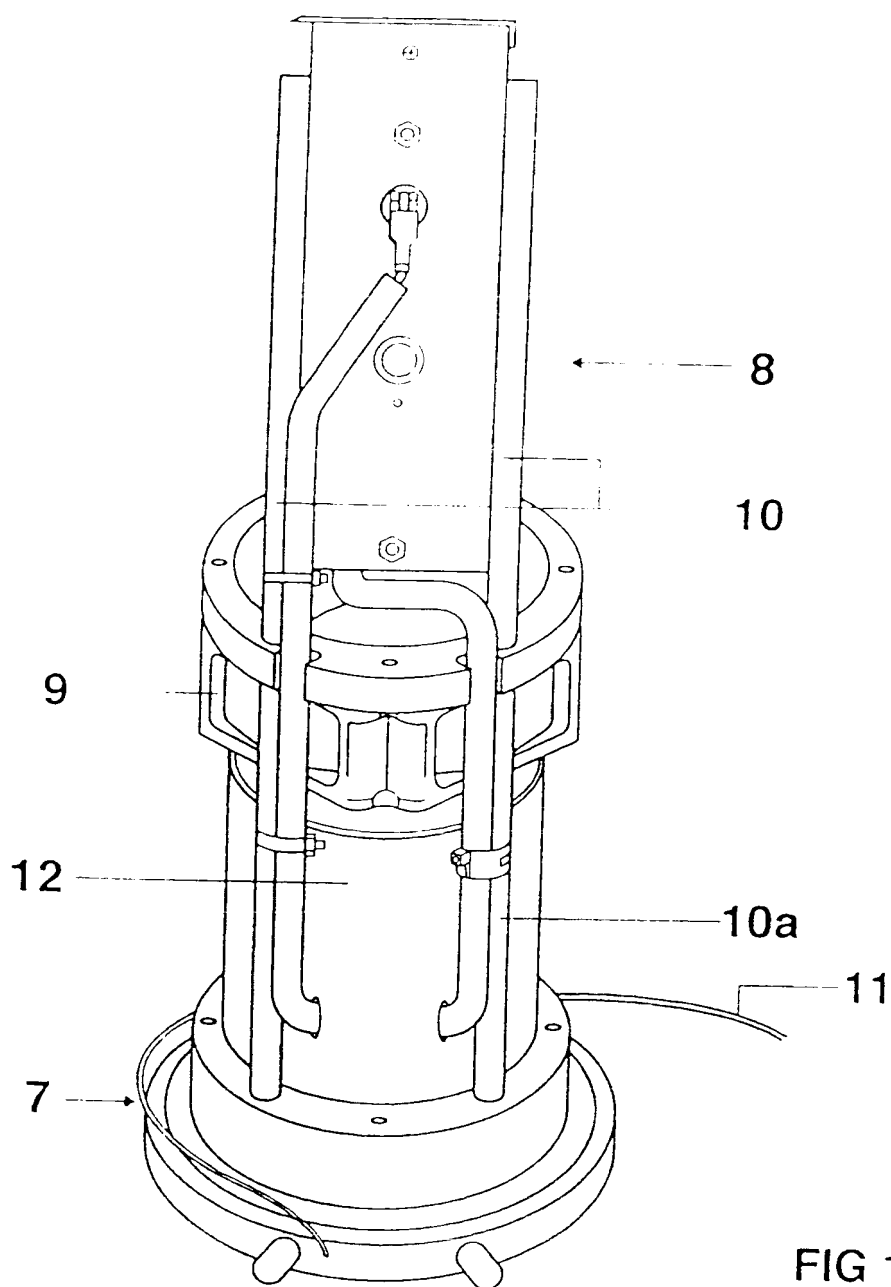


FIG 1a

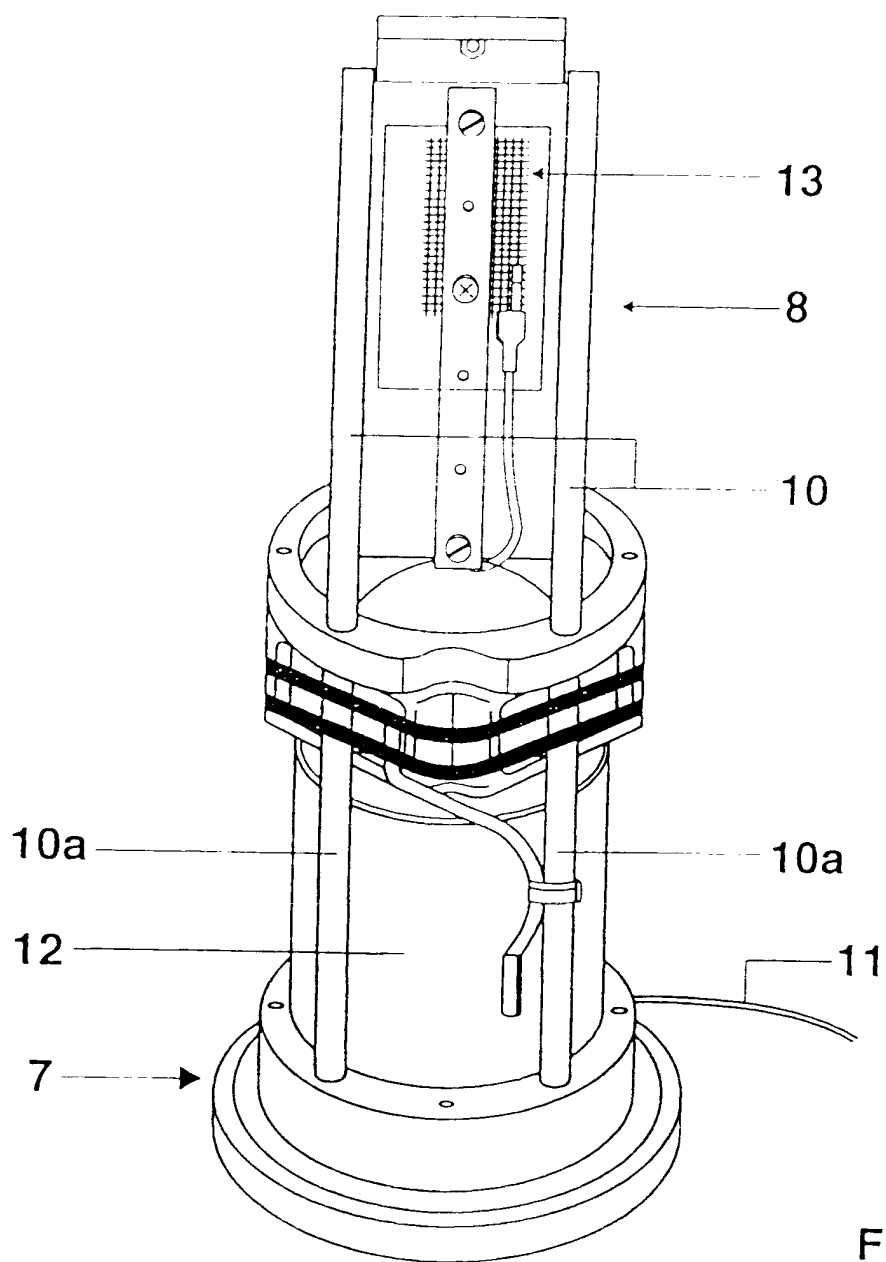
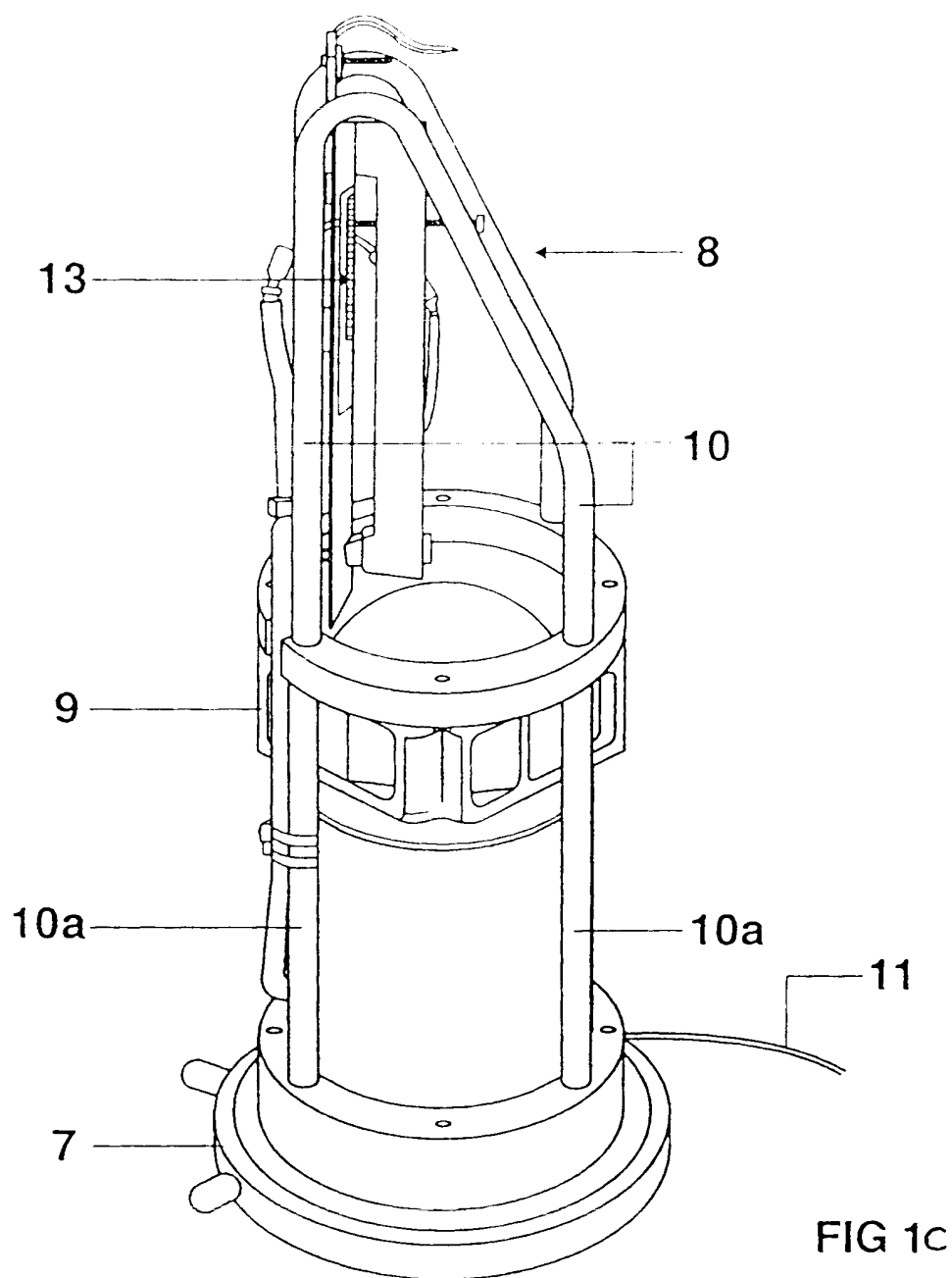


FIG 1b





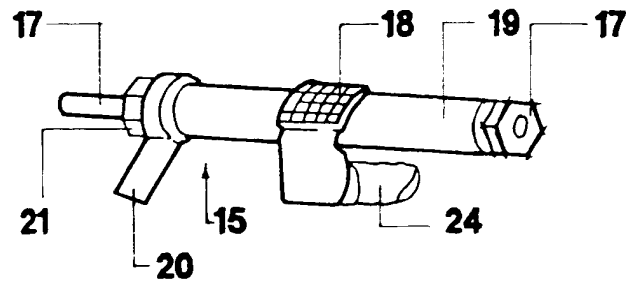


FIG 2.

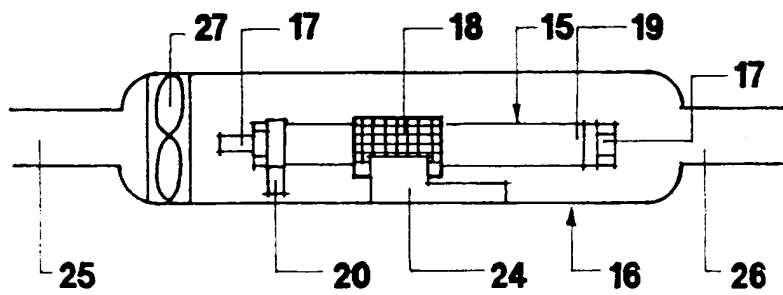


FIG 3.

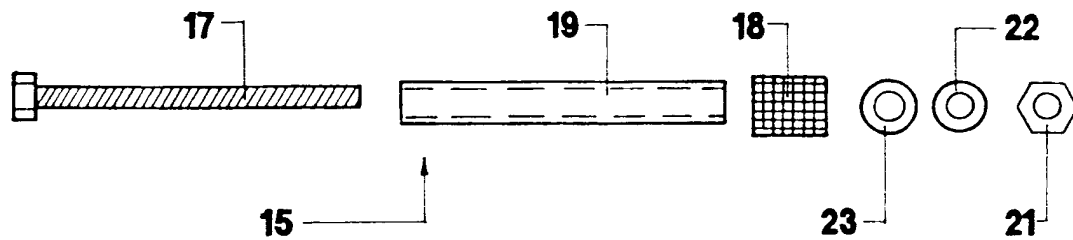


FIG 4.

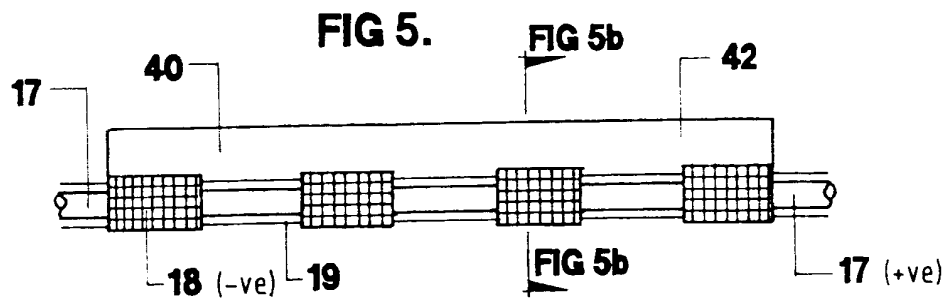
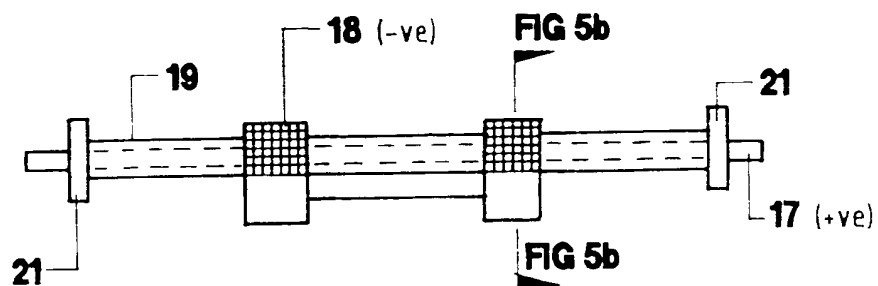


FIG 5a.

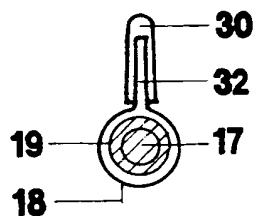


FIG 5b.

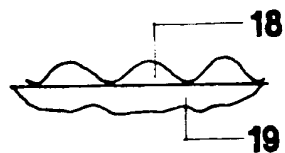


FIG 5c.

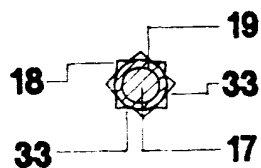
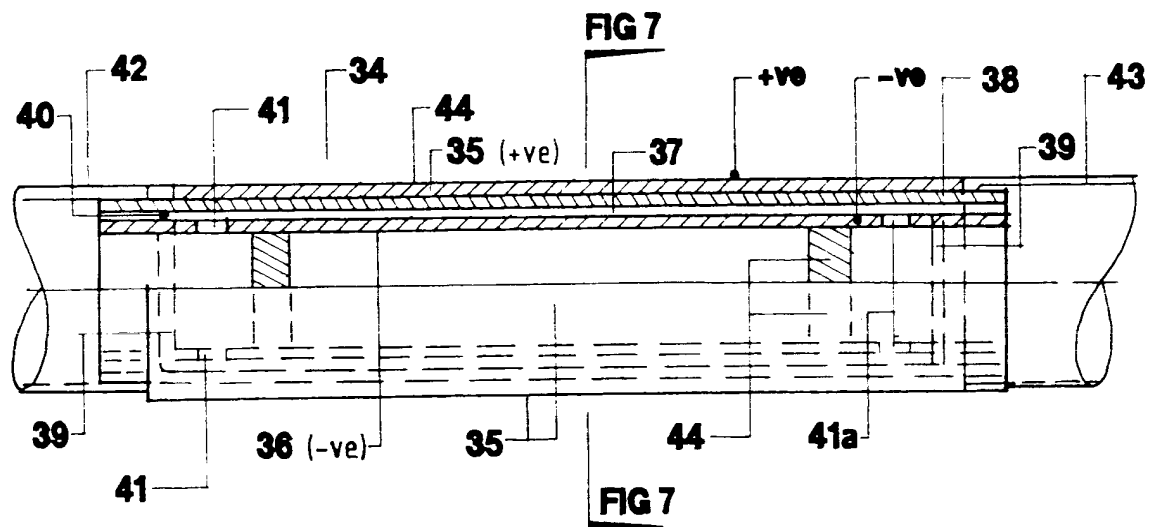
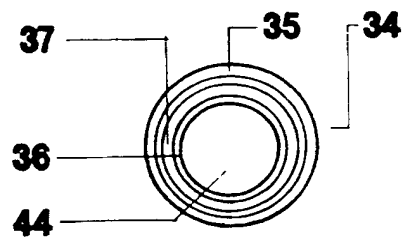


FIG 5d.

**FIG 6.****FIG 7.**

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/AU00/00617

**A. CLASSIFICATION OF SUBJECT MATTER**

Int. Cl. H01T 19/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
H01T, C01B, A61L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
DWPI

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 89/00975 A (LEICHER) 9 February 1989 Whole document, especially page 6 first full paragraph	1, 3, 4
X	AU 71368/91 A (CLEARWATER ENG PTY LTD) 26 September 1991 Whole document	1 to 3, 5 to 8
X	US 3967131 A (SLIPIEC et al.) 29 June 1976 Whole document	1, 4, 5 to 8

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"I" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search  
11 October 2000

Date of mailing of the international search report  
13.10.00

Name and mailing address of the ISA/AU

Authorized officer

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INTERNATIONAL SEARCH REPORT  
Information on patent family members

International application No.  
**PCT/AU00/00617**

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
WO	89/00975	AU	21344/88				
AU	71368/91	CA	2081014	US	5516493	WO	92/14677
US	3967131	NIL					
							END OF ANNEX

REC'D 08 MAY 2001

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Applicant's or agent's file reference 005005pc	<b>FOR FURTHER ACTION</b>	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA 416).
International Application No. <b>PCT/AU00/00617</b>	International Filing Date ( <i>day/month/year</i> ) 31 May 2000	Priority Date ( <i>day/month/year</i> ) 31 May 1999
International Patent Classification (IPC) or national classification and IPC <b>Int. Cl.<sup>7</sup> H01T 19/00</b>		
Applicant <b>HEAD START (QLD) PTY. LTD. et al</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
- ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheet(s).

3. This report contains indications relating to the following items:

- |      |                                     |   |
|------|-------------------------------------|---|
| I    | <input checked="" type="checkbox"/> | Basis of the report   |
| II   | <input type="checkbox"/>            | Priority  |
| III  | <input type="checkbox"/>            | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability  |
| IV   | <input type="checkbox"/>            | Lack of unity of invention  |
| V    | <input checked="" type="checkbox"/> | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| VI   | <input type="checkbox"/>            | Certain documents cited   |
| VII  | <input type="checkbox"/>            | Certain defects in the international application  |
| VIII | <input checked="" type="checkbox"/> | Certain observations on the international application   |

Date of submission of the demand 22 December 2000	Date of completion of the report 26 April 2001
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer  <b>M.J. O'ROURKE</b> Telephone No. (02) 6283 2017

**I. Basis of the report**

1. With regard to the **elements** of the international application:\*
- ☒ the international application as originally filed.
- ☐ the description,      pages , as originally filed,  
   pages , filed with the demand,  
   pages , received on      with the letter of
- ☐ the claims,      pages , as originally filed,  
   pages , as amended (together with any statement) under Article 19,  
   pages , filed with the demand,  
   pages , received on      with the letter of
- ☐ the drawings,      pages , as originally filed,  
   pages , filed with the demand,  
   pages , received on      with the letter of
- ☐ the sequence listing part of the description:  
   pages , as originally filed  
   pages , filed with the demand  
   pages , received on      with the letter of
2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.  
These elements were available or furnished to this Authority in the following language      which is:
- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, was on the basis of the sequence listing:
- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished
4. ☐ The amendments have resulted in the cancellation of:
- ☐ the description,      pages
- ☐ the claims,      Nos.
- ☐ the drawings,      sheets/fig.
5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Claims <b>2, 7, 9</b>	<b>YES</b>
	Claims <b>1, 3 to 6 and 8</b>	<b>NO</b>
Inventive step (IS)	Claims <b>9</b>	<b>YES</b>
	Claims <b>1 to 8</b>	<b>NO</b>
Industrial applicability (IA)	Claims <b>1 to 9</b>	<b>YES</b>
	Claims	<b>NO</b>

**2. Citations and explanations (Rule 70.7)**

**Novelty - Claims 1,3 to 6 and 8**

- Claims 1, 3 and 4 lack novelty in light of WO 89/00975. The tight-fitting mesh electrode mentioned in the first full paragraph of page 6 anticipates the "interference fit".
- Claims 1, 3 and 5, 6 and 8 lack novelty in light of AU 71368/91. The wire outer electrode is held onto the dielectric member by an interference fit.
- Claims 1, 4 and 5, 6 and 8 lack novelty in light of US 3967131.

**Inventive Step - Claims 1 to 8**

- Claims 2 and 7 lack an inventive step in light of AU 71368/91. These claims represent merely un inventive applications of common general knowledge.
- Claim 7 lacks an inventive step in light of US 3967131. This claim represents merely an un inventive application of common general knowledge.

**Novelty and Inventive Step - Claim 9**

Claim 9 is both novel and inventive in light of the known prior art, which neither discloses nor fairly suggests an inner electrode provided with wall apertures which allow air to enter and exit the air gap and internal blocks which divert airflow from the air gap.

**Industrial Applicability - Claims 1 - 9**

Claims 1 to 9 are considered to be industrially applicable.



**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claim 1 is not fully supported by the description in that it requires that the "elongate positive electrode is an interference on the elongate negative electrode." In the description, the mesh electrode is fitted onto the dielectric.